WHAT IS CLAIMED IS

1. A method of separating immiscible liquids in a dispersion comprising an aqueous liquid and at least one non-aqueous liquid immiscible in the aqueous liquid and wherein the non-aqueous liquid is dispersed in the aqueous liquid, comprising:

a) feeding the dispersion from a feed supply to a chamber housing a plurality of coalescing zones, in a first direction through the zones from an initial upstream zone to a final downstream zone;

b) partially coalescing the dispersed non-aqueous liquid in said coalescing zones;

c) recovering a partially coalesced emulsion of said liquids, downstream of said final downstream zone, and

d) periodically discontinuing the feeding in said first direction and feeding said emulsion in a second direction, counter to said first direction, such that said final downstream zone of a) becomes a second direction initial upstream zone and said initial upstream zone of a) becomes a second direction final downstream zone.

2. A method according to claim 1, further comprising:

e) feeding the partially coalesced emulsion to a polishing vessel, housing at least one polishing coalescing zone, in a first polishing direction;

f) partially coalescing the emulsion in the at least one polishing coalescing zone;

g) recovering a polished aqueous phase and a polished non-aqueous phase, and

h) periodically discontinuing the feeding of the partially coalesced emulsion in said first polishing direction and feeding said emulsion in a second polishing direction, counter to said first polishing direction, such that a final downstream polishing zone becomes an initial upstream polishing zone and said initial polishing zone becomes a final downstream zone.

3. A method according to claim 2, wherein the polishing vessel includes only one coalescing zone.

4. A method according to claim 2 to 3, wherein the dispersion also contains solids.

5. A method according to claim 4, wherein a solids stream is further recovered in g) from the polishing vessel.

6. A method according to any one of claims 1 to 5, wherein the method is continuous or discontinuous.

7. A method according to any one of claims 1 to 6, wherein the method is continuous.

8. A method according to claim 1, further comprising monitoring a differential pressure of the said initial upstream zone of a) as a means of measuring a level of blockage in said initial upstream zone, and performing d) in response to the a predetermined level of blockage in the initial upstream zone.

9. A method according to claim 1, wherein the plurality of coalescing zones is at least three.

10. A method according to claim 9, wherein the plurality of coalescing zones is six, the zones being disposed in two parallel series of three coalescing zones.

11. A method according to any one of claims 1 to 10, wherein the coalescing zone contains a coalescing media with a substantially homogeneous porous mass, the porous mass including a network of fine filaments and substantially uniform sized open cells in the filaments, wherein the coalescing media can separate non-aqueous emulsions from the aqueous phase having a droplet diameter of at least 0.5 μm.

12. A method according to claim 11, wherein the porous mass has an absorption or adsorbent character effective to trap dispersed non-aqueous droplets for coalescence, and readily release coalesced droplets of the non-aqueous liquid.

13. A method according to claim 11 or 12, wherein the porous mass has a non-compressed state.

14. A method according to claim 13, wherein the porous mass in the non-compressed state has a non-compressed density varying from 1.5 to 2.5 lbs/ft^3; a void space from 80% to 98%: and 65 to 120 pores per linear inch.

15. A method according to claim 11 or 12, wherein the porous mass has a compressed state.

16. A method according to claim 15, wherein the porous mass in the compressed state has a compressed density varying from 2.5 to 19 lbs/ft^3; a void space of from 60% to 80%; and 120 to 900 pores per linear inch.

17. A method according to any one of claims 11 to 16, wherein the cells have a cell wall thickness between 40 and 55 μm.

18. A method according to any one of claims 11 to 17, wherein the cells have a cell diameter between 160 and 220 μm.

19. A method according to any one of claim 11 to 18, wherein the coalescing media is of a polymer selected from the group consisting of polyurethane, polyester, polystyrene, polypropylene and polyethylene.

20. A method according to claim 19, wherein the coalescing media is of polyurethane.

21. An apparatus for separating immiscible liquids in a dispersion comprising an aqueous liquid and at least one non-aqueous liquid immiscible in the aqueous liquid and wherein the non-aqueous liquid is dispersed in the aqueous liquid, comprising:

a primary vessel including;

an inlet means through which the dispersion enters the vessel and producing a flow within the vessel in a first direction;

an outlet means through which a partially coalesced emulsion leaves the vessel;

a plurality of coalescing compartments which the dispersed non-aqueous liquid partially coalesces to produce the partially coalesced emulsion; the compartments including a first direction upstream compartment and a first direction last downstream compartment;

a flow direction changing means acting on the inlet means and the outlet means for periodically changing the flow within the vessel to a second direction counter to the first direction, such that said first direction upstream compartment becomes a second direction last downstream compartment and said first

direction last downstream compartment becomes a second direction upstream compartment.

22. An apparatus according to claim 20, further comprising:

a transferring means, communicating between said primary vessel and a polishing vessel;

the polishing vessel including;

a polishing inlet means through which the partially coalesced emulsion enters the polishing vessel in a first polishing direction;

at least one polishing coalescing compartment in which the partially coalesced liquid further coalesces to produce a polished non-aqueous phase and a polished aqueous phase;

a polished non-aqueous phase outlet means; and

a polishing outlet means through which a polished aqueous phase leaves the polishing vessel, and

a polishing flow direction changing means acting on the polishing inlet means and the polishing outlet means for periodically changing the flow within the polishing vessel to a second polishing direction counter to the first polishing direction.

23. An apparatus according to claim 21 or 22, wherein the apparatus operates in a continuous or discontinuous mode.

24. An apparatus according to claim 23, wherein the apparatus operates in a continuous mode.

25. An apparatus according to claim 22, wherein the polishing vessel further includes a solids removal outlet means for the removal of solids in the dispersion.

26. An apparatus according to claim 21, wherein the plurality of coalescing compartments is at least 3.

27. An apparatus according to claim 26, wherein the plurality of coalescing compartments is 6 and the compartments are arranged in two parallel series of three coalescing compartments.

28. An apparatus according to claim 27, wherein the coalescing compartments are disposed vertically.

29. An apparatus according to claim 21, wherein the primary vessel is cylindrical, disposed horizontally and includes heads.

30. An apparatus according to claim 21, wherein the coalescing compartments are disposed vertically in the cylindrical vessel to produce compartments with a circular cross section of the flow in the first direction.

31. An apparatus according to claim 22, wherein the polishing vessel is cylindrical, disposed horizontally and includes heads.

32. An apparatus according to claim 22, wherein the number of polishing coalescing compartments is one, disposed vertically in the cylindrical vessel to produce a circular cross section in the first polishing direction.

33. An apparatus according to claim 22, wherein the polishing vessel is cylindrical, disposed vertically and includes heads.

34. An apparatus according to claim 22, wherein the number of polishing coalescing compartments is one, disposed horizontally.

35. An apparatus according to claim 21, wherein

the primary vessel is disposed horizontally and comprises;

a cylindrical housing having a top wall, ends, and heads mounted on the ends of the housing;

a first inlet mounted centrally on the housing and two inlets mounted on the heads;

three outlets mounted on the top wall, a first outlet centrally mounted between two outlets adjacent to the ends;

six coalescing compartments mounted vertically and spaced substantially equally throughout the housing, each coalescing compartment and being separated by a liquid compartment,

the flow in the first direction is established with a first control valve opening to allow the dispersion into the first inlet, a second control valve remaining closed, a third control valve opened to collect the partially coalesced emulsion from the two outlets adjacent to the ends, and a fourth control valve closed;

the flow in the second direction is established with the first control valve closed, the second control valve opened to allow the dispersion to flow into the each of the two inlets mounted on the heads, the third control valve is closed and the fourth control valve opening to allow the first outlet centrally

mounted on the housing to allow the partially coalesced emulsion to leave the primary vessel; and

differential pressure controllers measuring differential pressure across each of the coalescing compartments, the differential pressure increasing with time, at a particular pressure and at a particular time interval the controllers actuating the control valves and changing the flow from the first direction to the second direction, after the time interval has passed for a second time, the controllers actuating the control valves and changing the flow from the second direction to the first direction.

36. An apparatus according to claim 22, wherein the transferring means is a pipe connecting the primary vessel and the polishing vessel;

the polishing vessel is disposed horizontally and comprises

a cylindrical housing having a top wall, ends and heads mounted on the ends of the housing;

one polishing coalescing compartment mounted vertically located at the center of the housing

an polishing inlet and a polishing outlet through which the partially coalesced emulsion and the polished aqueous phase are interchangeable passed;

the polishing flow in the first polishing direction is established with a first polishing control valve open allowing the emulsion into the polishing vessel through a port on the first head, a second polishing control valve is closed, a third polishing control

valve is closed and a fourth polishing control valve is open allowing the polished aqueous phase to leave the polishing vessel;

the polishing flow in the second polishing direction is established with a first polishing control valve closed, a second polishing control valve is open allowing the emulsion into the polishing vessel through a port on the first head, a third polishing control valve is open allowing the polished aqueous phase to leave the polishing vessel and a fourth polishing control valve is closed; and

differential pressure controllers measuring differential pressure across each of the polishing coalescing compartment, the differential pressure increasing with time, at a particular pressure and at a particular time interval the controllers actuating the control valves and changing the flow from the first polishing direction to the second polishing direction, after the time interval has passed for a second time, the controllers actuating the control valves and changing the flow from the second polishing direction to the first polishing direction.

37. An apparatus according to any one of claims 21 to 36, wherein the coalescing compartments contains a coalescing media with a substantially homogeneous porous mass, the porous mass including a network of fine filaments and substantially uniform sized open cells in the filaments, wherein the coalescing media can separate non-aqueous emulsions from the aqueous phase having a droplet diameter of at least 0.5 μm.

38. An apparatus according to claim 37, wherein the porous mass has an absorption or adsorbent character effective to trap dispersed non-aqueous droplets for coalescence, and readily release coalesced droplets of the non-aqueous liquid.

39. An apparatus according to claim 37 or 38, wherein the porous mass has a non-compressed state.

40. An apparatus according to claim 39, wherein the porous mass in the non-compressed state has a non-compressed density varying from 1.5 to 2.5 lbs/ft^3; a void space from 80% to 98%: and 65 to 120 pores per linear inch.

41. An apparatus according to claim 37 or 38, wherein the porous mass has a compressed state.

42. An apparatus according to claim 41, wherein the porous mass in the compressed state has a compressed density varying from 2.5 to 19 lbs/ft^3; a void space of from 60% to 80%; and 120 to 900 pores per linear inch.

43. An apparatus according to any one of claims 37 to 42, wherein the cells have a cell wall thickness between 40 and 55 μm.

44. An apparatus according to any one of claims 37 to 43, wherein the cells have a cell diameter between 160 and 220 μm.

45. An apparatus according to any one of claim 37 to 44, wherein the coalescing media is of a polymer selected from the group consisting of polyurethane, polyester, polystyrene, polypropylene and polyethylene.

46. An apparatus according to claim 45, wherein the coalescing media is of polyurethane.

47. In an apparatus for separating immiscible liquids in a dispersion comprising an aqueous liquid and at least one non-aqueous liquid immiscible in the aqueous liquid and wherein the non-aqueous liquid is dispersed in the aqueous liquid and a coalescing media is used for separating the liquids in the dispersion by passing the dispersion through the coalescing media,

the improvement wherein

the coalescing media includes a substantially homogeneous porous mass, the porous mass including a network of fine filaments and substantially uniform sized open cells in the filaments, wherein the coalescing media can separate non-aqueous emulsions from the aqueous phase having a droplet diameter of at least 0.5 µm.

48. An apparatus according to claim 47, wherein the porous mass has an absorption or adsorbent character effective to trap dispersed non-aqueous droplets for coalescence, and readily release coalesced droplets of the non-aqueous liquid.

49. An apparatus according to claim 47 or 48, wherein the porous mass has a non-compressed state.

50. An apparatus according to claim 49, wherein the porous mass in the non-compressed state has a non-compressed density varying from 1.5 to 2.5 lbs/ft^3; a void space from 80% to 98%: and 65 to 120 pores per linear inch.

51. An apparatus according to claim 47 or 48, wherein the porous mass has a compressed state.

52. An apparatus according to claim 51, wherein the porous mass in the compressed state has a compressed density varying from 2.5 to 19 lbs/ft^3; a void space of from 60% to 80%; and 120 to 900 pores per linear inch.

53. An apparatus according to any one of claims 47 to 52, wherein the cells have a cell wall thickness between 40 and 55 μm.

54. An apparatus according to any one of claims 47 to 53, wherein the cells have a cell diameter between 160 and 220 μm.

55. An apparatus according to any one of claim 47 to 54, wherein the coalescing media is of a polymer selected from the group consisting of polyurethane, polyester, polystyrene, polypropylene and polyethylene.

56. An apparatus according to claim 55, wherein the coalescing media is of polyurethane.

AMENDED CLAIMS
received by the International Bureau on 16 February 2004
claims 57, 58 & 59 have been added.

53. An apparatus according to any one of claims 47 to 52, wherein the cells have a cell wall thickness between 40 and 55 µm.

54. An apparatus according to any one of claims 47 to 53, wherein the cells have a cell diameter between 160 and 220 µm.

55. An apparatus according to any one of claim 47 to 54, wherein the coalescing media is of a polymer selected from the group consisting of polyurethane, polyester, polystyrene, polypropylene and polyethylene.

56. An apparatus according to claim 55, wherein the coalescing media is of polyurethane.

57. A method according to any one of claims 11 to 20, wherein the coalescing medium separates non-aqueous emulsions from the aqueous phase having the droplet diameter in the range of 0.5 to 2 micron.

58. An apparatus according to any one of claims 37 to 46, wherein the coalescing media separates non-aqueous emulsions from the aqueous phase having the droplet diameter in a range of between 0.5 and 2 micron.

59. An apparatus according to any one of claims 47 to 56, wherein the coalescing medium separates non-aqueous emulsions from the aqueous phase having the droplet diameter of 0.5 to 2 micron.